DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF PUERTO RICO
ECONOMIC DEVELOPMENT ADMINISTRATION
INDUSTRIAL RESEARCH DEPARTMENT

MISCELLANEOUS GEOLOGIC INVESTIGATIONS
MAP I – 520

DESCRIPTION OF MAP UNITS

UNCONSOLIDATED DEPOSITS

Qa *Alluvial deposits,* gravel, sand, and clay in flood plains and alluvial fans; includes some terrace deposits and artificial fill at Lago El Guineo dam.

Qt *Terrace deposits,* sand, silt, clay, and gravel deposits above valley floors; includes some alluvial and colluvial deposits.

Ql *Landslide deposits,* debris slides, rock slides, debris avalanches, earth flows, and some colluvium; locally includes blocks of volcanic and sedimentary rocks as large as 10 m; large deposits form generally hummocky terrain.

SEDIMENTARY, PLUTONIC, AND VOLCANIC ROCKS

Ti *Dacite stocks, dikes, and plugs,* bluish-green or greenish-gray porphyry containing phenocrysts of feldspar, hornblende, some pyroxene, and rare quartz in a cloudy or granular-appearing groundmass of feldspar, quartz, and chlorite; weathers to white or brown soils. Samples from the stock in the Río Jauca valley and several dikes contain from 52 to 61 percent silica and are largely dacite by the classification of Rittman (1952). Small bodies of volcanic and sedimentary rocks are contained by the dacite. At most places it is distinguishable from lavas of the Anón Formation only by intrusive relations, metamorphic effects, or by lack of common amygdaloidal material. The dacite and the Anón Formation probably are contemporary.

Anón Formation (1,400 m+)

Tat, *Massive lapilli tuff, coarse tuff, and coarse vitric tuff,* containing fragments as large as 30 cm in diameter. Overall color ranges from green to greenish brown and bluish gray, controlled by the relative proportions of green, greenish-brown, reddish-brown, and brown glass fragments containing felted or trachytic feldspar microlites. Other fragments are andesite or dacite, with hornblende, pyroxene, feldspar, and rare quartz phenocrysts and crystal fragments of feldspar, hornblende, and rare pyroxene. Shard structure is rare. Sparse cement is chlorite, zeolite, and chalcedony. The massive tuffs are intercalated with subordinate dacite lava.

Tas, *Tuffaceous mudstone and sandstone,* generally calcareous.

Tal, *Dacite lava,* bluish- or greenish-gray porphyry containing sparse to common phenocrysts of hornblende, plagioclase, some pyroxene, and rare quartz most commonly in a granular-appearing groundmass of felty or trachytic feldspar microlites with interstitial chloritic or glassy material, but locally in a cloudy-appearing feldspar-mosaic groundmass. Quartz, chalcedony, and chlorite amygdules are common in some lavas and locally are elongate parallel to trachytic flow directions. Some glassy, sparsely porphyritic lava forms flow breccia or auto breccia. The lava is intercalated with subordinate lapilli tuff and tuff.

Ta, *Anón Formation, undivided,* intercalated dacite lava, massive tuff, and tuffaceous mudstone and sandstone. Near stocks and some faults rocks of the Anón commonly are pyritized and altered to calcite and epidote. The Anón interfingers extensively with Monserrate Formation, and underlies the Monserrate near Hacienda Cortada.

Tm *Monserrate Formation* (0–160 m+), laminated and thin- to medium-bedded reddish-gray, greenish-gray, and purplish-gray mudstone and tuffaceous sandstone, commonly calcareous and foraminiferal. Includes some beds of fine conglomerate, tuff, and lapilli tuff, and green and greenish-brown vitric tuff beds, similar to coarse vitric tuff of the Anón Formation, in most exposures. Feldspar, quartz, and green chloritized rock fragments are the most common pyroclastic components.

Río Prieto Formation (0–460 m)

Tpt, *Massive lapilli tuff,* bluish-gray, purple weathering, and subordinate interbeds of thin- to medium-bedded tuffaceous sandstone and coarse tuff and rare mudstone lenses. Hornblende and feldspar and some quartz crystals, and fragments of porphyritic and aphanitic volcanic rocks and some greenish chloritized volcanic rocks are the chief pyroclastic components. Plutonic rock fragments are rare. Calcite cement and some limestone fragments occur locally.

Tps, *Tuffaceous sandstone, siltstone, and mudstone,* laminated to thin- and medium-bedded, intercalated with some lapilli tuff and volcanic breccia. Rock is greenish to purplish gray in color, and weathers to purple saprolite.

Tpl, *Calcarenite and calcirudite,* massive, light-gray, containing abundant algal fragments and scattered corals. Gradational relations to the Miramar Formation shown by the appearance of volcanic rock fragments and a change in color to pinkish white and pink near the base. In the Rio Guayo contains volcanic rock fragments throughout.

TKmi *Miramar Formation* (0–130 m), poorly sorted red conglomerate and conglomeratic mudstone with lenses and beds of reddish algal limestone at the base. Clasts are chiefly well-rounded red and purple andesite derived from the Achiote Conglomerate. Clasts eroded from other units are subordinate and generally angular. The red siltstone and mudstone matrix contains fragments of calcareous algae and locally grades into pink algal limestone.

TKp *Volcanic dikes and sills,* grayish-blue, greenish-blue, and bluish-gray porphyritic basalt, andesite, and dacite in resistant steeply dipping tabular bodies as much as 50 m thick but most commonly 5 to 10 m in thickness. Phenocrysts include feldspar, hornblende, some pyroxene, and rare quartz. Included in this map unit is coarsely crystalline gabbro or diorite in four west-trending dikes in the southeastern part of the quadrangle, a sill at Hacienda Tabonuco, and another sill in the Tetuán Formation between Los Tres Picachos and Hacienda Ralate.

TKg *Plutonic igneous rocks,* chiefly grayish-white medium-grained granodiorite in plutons forming the southeastern extension of the Utuado batholith (Weaver, 1958). Border zones of plutons commonly are quartz diorite and some diorite, and some dikes and small plugs of quartz monzonite and pink granodiorite also occur. Granodiorite and quartz diorite are composed of subhedral laths of plagioclase feldspar, subhedral crystals or interstitial anhedral grains of hornblende and some biotite, an interstitial mosaic of quartz and potassium feldspar, and accessory magnetite, pyrite, apatite, and zircon. Diorite contains plagioclase, hornblende, sparse quartz, and sparse potassium feldspar; quartz monzonite is rich in potassium feldspar. Plutonic rocks near the edge of the batholith contain common accessory chalcopyrite. The plutonic rocks are chiefly granitoid or intergranular in texture, but in the plutons near Hacienda Jurutungo, near Río Saliente, and near Quebrada de Cacaos are mostly porphyritic. The grain size of most plutonic rocks ranges from 1 to 3 mm, but in the porphyritic rocks quartz, hornblende, and plagioclase form euhedral and subhedral crystals as much as 10 mm in length or diameter in a groundmass of plagioclase, quartz, and potassium feldspar. The Miramar Formation of Late Cretaceous to Eocene age rests unconformably on batholithic rocks (Mattson, 1966a), but plutonic rocks were emplaced in the Upper Cretaceous Coamo Formation.

The age of intrusion is therefore most likely latest Cretaceous (Campanian or Maestrichtian) or Paleocene, but possibly early Eocene. Rock samples JM 1-382 (136,760 m E.; 41,880 m N.; Puerto Rico rectangular coordinate system) and JM 1-415 (137,920 m E.; 42,390 m N.) were dated by the lead-alpha method and yielded ages of 60±10 and 50±10 million years respectively (T. W. Stern, written commun., 1962). Biotite from the latter sample was also dated by the K-Ar method yielding a calculated age of 65±3.25 million years (unpublished analyses by H. H. Thomas, R. F. Marvin, and F. G. Walthall, 1962). These radiometric age determinations confirm the general age of plutonic intrusion interpreted from the field relations.

TKm *Contact metamorphic rocks,* hornfels, schist, and finely layered gneiss, perhaps metamorphosed equivalents of the Jayuya Tuff, and altered layered clastic rocks, perhaps metamorphosed Robles Formation. Metamorphic effects are common adjacent to plutons, but in most cases identifiable relicts permit correlation and mapping with unmetamorphosed equivalents.

Kg *Lago Garzas Formation* (1,700 m in adjacent areas), chiefly red conglomeratic tuff, purple lapilli tuff and breccia, and some massive laminated mudstone in the small area of exposure in this quadrangle. In adjacent areas the Lago Garzas is principally andesite lava.

Kc *Coamo Formation* (300 m+), chiefly massive salt-and-pepper tuff, green tuff, and muddy tuff, all ranging from coarse tuff to fine volcanic breccia containing fragments as large as 20 cm in diameter. Salt-and-pepper tuff is generally well sorted and contains crystal fragments of feldspar, hornblende, scarce or rare quartz, and rare biotite(?) and porphyritic and aphanitic volcanic rock fragments; it is speckled green and white or black and white in color. Green tuff is generally somewhat coarser and contains fewer crystals, less hornblende, and more green lithic fragments. Muddy tuff chiefly consists of fragments of feldspar and volcanic rocks contained in matrix of clay and silt-sized chloritic material that comprises as much as 40 percent of the rock. One dark-bluish-gray pyroxene andesite(?) flow or sill is exposed at 142,600 m E.; 34,360 m N.

Kcl, *Limestone,* dark wavy-bedded, containing fragments of rudists, bryozoa, and Foraminifera.

Km *Maravillas Formation* (380–560 m+), medium- to thick-bedded muddy, dark-colored feldspathic sandstone, and siltstone, dark mudstone, green coarse crystal-lithic tuff, and silty brown coarse crystal tuff. Chief constituents of tuffs are crystals of feldspar, amphibole, pyroxene, and rare quartz and fragments of green finely trachytic and felty-textured volcanic rocks set in a matrix of calcite, chlorite, and zeolite, with some compressed perlitic material. Thin hornblende-feldspar porphyry dikes and sills are common in the area of outcrop of the Maravillas Formation. Locally the formation has been epidotized, silicified, and (or) pyritized.

Kml, *Fragmental limestone lens.*

Kmt, *Massive lapilli tuff and coarse tuff,* similar in composition to tuffs described above.

Ka *Achiote Conglomerate* (200–1,800 m), massive red volcanic conglomerate interbedded with subordinate green tuffaceous conglomeratic sandstone and conglomerate and less common thin- and medium-bedded red and greenish-gray tuffaceous sandstone and red mudstone. Conglomeratic clasts are as large as 150 cm, but commonly average no more than 12 cm in diameter in single outcrops. The most common clasts are red, purple, or greenish-gray volcanic porphyries, chiefly basalt and andesite similar to flows in the Jayuya, Vista Alegre, Cotorra, and other formations in the quadrangle, but less commonly feldspar-quartz, feldspar-hornblende, and feldspar-pyroxene-biotite porphyries, not common in the older rocks. Other less common clasts are tuff, siltstone, limestone, rare fossils, and red chert. The matrix of red conglomerate is chiefly feldspar grains and red hematitic pellets in a red mudstone, but small chloritized and unmetamorphosed porphyritic volcanic rock grains and pyroxene, hornblende, and magnetite also occur. The green rocks lack the hematitic pellets and the mudstone. Cement commonly is calcite, chlorite, and zeolite.

Kas, *Volcanic siltstone and sandstone, minor tuff, rare limy sandstone.*

Kct *Cotorra Tuff* (0–460 m), massive dark-green and greenish-black coarse tuff and lapilli tuff interbedded with minor volcanic breccia and basalt lava flows. Monoclinic pyroxene crystals and fragments of pyroxene porphyry predominate, whereas feldspar and hornblende crystals and fragments of hornblende and hornblende-pyroxene porphyries are rare. Calcite, chlorite, and zeolite cement the grains; some chlorite probably is devitrified volcanic glass. Basalt contains phenocrysts of augite and altered olivine(?) in a felty or trachytic matrix of feldspar, chlorite, and pyroxene. The basalt commonly is pillowed. Fragments in breccias are chiefly flow basalt.

Kma *Malo Breccia* (0–600 m), massive green and gray volcanic breccia, lapilli tuff, and coarse tuff, with rare volcanic sandstone, siltstone, and conglomerate. Tuffs and breccias contain fragments of volcanic porphyries, pumice, common feldspar, some pyroxene, and rare hornblende and biotite, in a matrix of chlorite, zeolite, and small feldspar crystals. The Malo Breccia is poorly exposed in the Jayuya quadrangle, where it is commonly epidotized, pyritized, and calcified.

Kt *Tetuán Formation* (460–1,200 m), thin- to medium-bedded and laminated green, gray, and lavender volcanic mudstone and sandstone interbedded with medium-bedded to massive coarse feldspar-crystal-lithic tuff, some conglomeratic volcanic sandstone, and rare olivine basalt flows.

Ktf, *Andesite flows.*

Kv *Vista Alegre Formation* (950–1,700 m), medium-bedded to massive dark-green coarse pyroxene-feldspar-crystal tuff interbedded with greenish coarse feldspar-crystal-lithic tuff and minor lapilli tuff, volcanic sandstone and siltstone, and laminated mudstone. Pyroxene and plagioclase crystal and volcanic rock fragments are abundant, but hornblende, biotite, and quartz are rare. Locally red volcanic scoria mottles the rock.

Kva, *Andesite flows.*

Kvm, *Basalt flows and pyroxene-bearing coarse tuff.* Pyroxene is predominant phenocryst in basalt, but feldspar is common, and pseudomorphs after olivine are found locally.

Kvb, *Volcanic breccia,* with lava and aphanitic volcanic rock fragments as large as 3 cm in diameter.

Kr *Robles Formation* (500–2,500 m), massive to medium-bedded and laminated green, greenish-purple, and bluish-gray mudstone interbedded with massive and laminated tuffaceous siltstone and sandstone, laminated pyroxene-bearing fine tuff, fine feldspathic tuff, subordinate green fine sedimentary breccia and basalt and andesite lava flows, and rare lenses of pyroxene-bearing lithic lapilli tuff. Near the batholith, the mudstone has been altered to a fine-grained siliceous rock, and the volcanic rocks have been silicified, epidotized, and pyritized to hornfels and gneiss.

Krl, *Limestone lenses,* metamorphosed to friable coarsely crystalline pure white marble.

Jayuya Tuff (900 m+)

Kjf, *Massive green and gray coarse feldspathic crystal tuff,* now chiefly altered to hornfels, interbedded with some metamorphosed andesite(?) flows and pyroxene-rich coarse tuff.

Kjs, *Laminated and medium-bedded greenish-gray silicified mudstone and thin-bedded tuffaceous sandstone.*

Kjm, *Massive dark pyroxene-rich coarse crystal tuff, pyroxene-rich lapilli tuff, and rare basalt flows and feldspathic crystal tuff,* chiefly metamorphosed to feldspar-hornblende hornfels, gneiss, and schist.

Base by U.S. Geological Survey, 1960
2000-meter grid based on Puerto Rico coordinate system

SCALE 1:20 000

CONTOUR INTERVAL 10 METERS
DATUM IS MEAN SEA LEVEL

Geology mapped in 1960–62

EXPLANATION

UNCONSOLIDATED DEPOSITS

Qa Alluvial deposits
Qt Terrace deposits
Ql Landslide deposits

Recent; Pleistocene(?) or Recent — QUATERNARY

SEDIMENTARY, PLUTONIC, AND VOLCANIC ROCKS

Ti Dacite stocks, dikes, and plugs — *Eocene(?)*

Tat **Tas** **Tal** **Ta**
Anón Formation
Tat, *tuff; some lava*
Tas, *tuffaceous mudstone and sandstone*
Tal, *dacite tuff; some breccia and tuff*
Ta, *undivided volcanic rocks*

Tm Monserrate Formation

Tpt **Tps** **Tpl**
Río Prieto Formation
Tpt, *tuff and volcanic sandstone; some mudstone lenses*
Tps, *mudstone and volcanic sandstone; some tuff*
Tpl, *algal limestone, conglomerate near base; some tuffaceous limestone*

Eocene — TERTIARY

TKmi Miramar Formation

UNCONFORMITY

TKp Volcanic dikes and sills

TKg Plutonic igneous rocks

TKm Contact metamorphic rocks

Upper Cretaceous and/or lower Tertiary — CRETACEOUS AND/OR TERTIARY

FAULT CONTACT

Kg Lago Garzas Formation

FAULT CONTACT

Kc **Kcl** Coamo Formation
Kcl, *calcilutite*

Km **Kml** **Kmt** Maravillas Formation
Kml, *limestone*
Kmt, *massive tuff*

Ka **Kas** Achiote Conglomerate
Kas, *volcanic sandstone and siltstone*

DISCONFORMITY(?)

Kct Cotorra Tuff

Kma Malo Breccia

Kt **Ktf** Tetuán Formation
Ktf, *andesite lava*

Upper Cretaceous

Kvm **Kva** **Kv** **Kvb** Vista Alegre Formation
Kva, *andesite lava*
Kvm, *basalt lava and tuff*
Kvb, *volcanic breccia*

Lower(?) and Upper Cretaceous

Kr **Krl** Robles Formation
Krl, *metamorphosed limestone*

Lower and Upper Cretaceous

Kjf **Kjs** **Kjm** Jayuya Tuff
Kjf, *feldspathic tuff and andesite(?) lava*
Kjs, *siltstone and mudstone*
Kjm, *pyroxene-rich tuff, minor feldspathic tuff, basalt lava, and siltstone*

Lower Cretaceous — CRETACEOUS

Contact
Dashed where approximately located; short dashed where indefinite or inferred

Fault
Dashed where approximately located; short dashed where inferred. U, *upthrown side;* D, *downthrown side; arrows show relative horizontal movement. In section:* T, *toward observer;* A, *away from observer*

Fault zone or shear zone

Anticline — Syncline
Folds
Showing crestline or troughline and direction of plunge if known; dashed where approximately located

Anticline — Syncline — Closely spaced fold axes showing direction of plunge (FA) — Horizontal fold axis (FA)
Minor fold axes

PLANAR FEATURES

30 Inclined — Vertical — Horizontal
Strike and dip of beds

22 Component of dip

52 Inclined — Vertical — Horizontal — 46 Crumpled (average)
Approximate strike and dip of beds

50 Inclined — Vertical — Approximate
Shear cleavage

85 Inclined — Vertical
Foliation

LINEAR FEATURES
May be combined with planar symbols

33 Measured — 85 Approximate
Bearing and plunge of lineation

20 Inclined — Vertical — 80 Multiple joint system — Horizontal
Joints

25 Inclined — Vertical — 26 Approximate
Narrow dikes

20 Bearing and plunge of cross-beds

73 Cp Inclined — Py Vertical
Vein, showing dip

Au Located — Py Approximate
Conspicuous mineral occurrence

Au, *gold;* Sph, *sphalerite;* Cp, *chalcopyrite;* Cu, *copper minerals;* Mo, *molybdenite;* Mt, *magnetite;* Py, *pyrite;* Hem, *hematite;* Z, *zinc*

6 Fossil locality referred to in Mattson (1967)

Unconformity
Shown on sections only

NOTE ON THE STRATIGRAPHY

Many of the stratigraphic names appearing on the geologic map of the Jayuya quadrangle have been established recently. Definitive descriptions of the Jayuya Tuff, Achiote Conglomerate, Maravillas Formation, Lago Garzas Formation, Río Prieto Formation, Monserrate Formation, and Anón Formation were made by Mattson (1967b); The Vista Alegre Formation and the Tetuán Formation were described by Nelson and Monroe (1966); and the Malo Breccia and Cotorra Tuff were defined by Briggs (1967).

The Coamo Formation was described earlier by Glover (1961) and the Robles Formation was defined by Pease and Briggs (1960).

Fossil assemblages collected from the localities marked on the geologic map are discussed in the report by Mattson (1967).

STRUCTURE

Rocks in the Jayuya quadrangle are broadly folded and highly faulted. The eastern third of the quadrangle (section B-B′) is on the southern flank of the principal anticline of Puerto Rico (Briggs and Gelabert, 1962), whose axial trace lies less than a kilometer north of the northeast corner of the quadrangle. Regional dips are as much as 30° or 40° in the north and 5° to 20° in the south. Cretaceous rocks in the remainder of the quadrangle form an anticline centered over the Utuado batholith (sections A-A′, C-C′). In the southern half of the quadrangle these two anticlines pass into each other without obvious discordance. In the northeast quadrant from Quebrada La Mina to the graben in the Río Cialitos, a fault separates the two anticlines, but north of the Cialitos graben a series of small, shallow, west-trending folds separates their opposing flanks. Similar small folds continue northward into Florida quadrangle (Nelson and Monroe, 1966) where they become the westernmost expression of the axis of the principal anticline of Puerto Rico. Thus the anticline containing the Utuado batholith can probably be considered the extension of the Puerto Rico anticline displaced southward into Jayuya quadrangle.

Lower Tertiary rocks are exposed in the north flank of a syncline in the southwest corner of the quadrangle (section D-D′). The axis of the syncline is in Ponce quadrangle to the south, where it bends into and is probably cut off by the San Patricio fault near the Jayuya quadrangle border.

Faults are numerous in Jayuya quadrangle. There are two separate systems of faults: an older system oriented about N. 85° W. and N. 15° E., and a slightly younger system oriented about N. 55° W. and N. 35° E. Some faults of the older system are cut by the batholith, as near Quebrada La Mina, and some faults of the younger system offset lower Tertiary rocks and batholithic rocks, as shown by the northeast-trending fault near Jayuya and the west end of the Cerro de Punta fault. However, some Tertiary or younger movement has also occurred in places on the generally older fault system, as perhaps shown by the eastern end of the Cerro de Punta fault.

Only two faults have been named. The Cerro de Punta fault crosses the quadrangle from east to west south of Cerro de Punta. The fault or fault zone shows left-lateral apparent horizontal displacement of 600 to 900 m and cuts lower Tertiary rocks; it also has some apparent vertical movement but, as is typical of strike-slip faults, with no one side consistently up or down. The San Patricio fault, crossing the southwest corner of the quadrangle, extends as an important fault in both directions; here it shows apparent normal movement forming (with a subsidiary fault) the south side of the Tertiary sequence.

A crescentic graben near the Río Cialitos in northeastern Jayuya quadrangle exposes Achiote Conglomerate within a terrain of the Vista Alegre Formation. The bounding faults cannot be traced eastward beyond a fault in the Río Toro Negro valley; westward they merge and are lost under deep soil near the north edge of the mapped area. Where the Achiote is not present along the fault there is no obvious lithologic change across it, and the fault is difficult to trace in the gently dipping rather uniform Vista Alegre Formation. Such a graben was probably formed by differential horizontal movement of the bounding blocks, permitting a slice of younger rocks to drop down. Clock-wise rotation of the block north of the graben and south of the large left-lateral Damián Arriba fault in Florida quadrangle (Nelson and Monroe, 1966) might cause right-lateral movement in Jayuya quadrangle, with the graben forming along curved fractures. One exposure near the north border of the graben shows small left-lateral shears, but small shears showing horizontal left-lateral movement are an almost ubiquitous feature of rock exposures in central and western Puerto Rico and may not relate to local structures.

Two important unconformities have been mapped in Jayuya quadrangle. An angular unconformity between lower Tertiary rocks and Upper Cretaceous rocks truncates the Utuado batholith (Mattson, 1966). Fossil data indicate that the unconformity is within the Campanian or Maestrichtian to middle Eocene interval (Mattson, (1967).

The Achiote Conglomerate rests upon the Malo Breccia and Cotorra Tuff in this quadrangle. The variation in lithology and thickness of the underlying units and the fluviatile or shallow marine nature of the overlying Achiote suggest that some subaerial erosion occurred prior to or contemporaneous with the deposition of the Achiote, although no angular discordance has been found. The time of this disconformity is Late Cretaceous, Coniacian or Santonian or slightly older. The disconformity has also been suggested by Glover (1961) and Briggs and Gelabert (1962) in areas 15 to 30 km eastward.

Faulting and folding occurred in at least two episodes, as shown by the angular unconformity between folded Cretaceous and folded Tertiary rocks. The two fault systems could be related to the two episodes: the earlier N. 85° W. and N. 15° E. system being formed in the Maestrichtian (or slightly older or younger) deformation, and the later N. 55° W. and N. 35° E. system being formed in or about late Eocene time. Not enough is known of fault patterns in the lower Tertiary rocks to be certain of this correlation. Moreover, the disconformity at the base of the Achiote Conglomerate, of probable Coniacian or Santonian age, may have been caused by uplift along faults presumably still in existence, but which cannot be distinguished in this highly faulted area.

Folding and igneous intrusion probably occurred concurrently during the Maestrichtian deformation, and folding and possibly some igneous intrusion also occurred during the Eocene deformation. Whether folding localized the batholithic intrusion, or vice versa, cannot be determined with certainty. However, the position of the batholith in Jayuya quadrangle coincides with a possible displacement of the anticlinorium about 6 km southward from a projection of its west-northwesterly trend in Florida, Orocovis, and Barranquitas quadrangles. This suggests that the intrusion was localized independently of fold axes, possibly due to changes in thickness of the stratigraphic section or changes in geothermal gradients, and that the intrusion may have forced the fold axes to conform with the intrusion, rather than the reverse relationship.

Faulting occurred during the deformation and intrusion, although movement may have begun earlier and continued later. The essential contemporaneity of many of the faults in the quadrangle is shown by relative offsets which do not support a simple age sequence for the various directions of faulting. Furthermore, forceful intrusion of the batholith to its present level has been accomplished in part by vertical movement along nearby faults. In this way the pattern of displacement generally shows uplift toward the batholith, and some individual short faults show large vertical movement. Striking examples are the northerly trending fault east of Los Tres Picachos, which brings the Robles Formation into contact with the Tetuán Formation, a displacement of at least 1,000 m; and faults in the Cerro Saliente and Monte Jayuya area, which bring the Achiote Conglomerate into contact with the Robles and Jayuya Formations. Displacement on this latter group of faults is not easily calculated because of facies changes in the Robles and because of the possibility of erosion in Achiote time or earlier.

The numerous faults, complex structures, and the deposition of 8,000 m of volcanic sediments largely in the Late Cretaceous and early Tertiary, with two periods of uplift and erosion (excluding the present period), one of which exposed plutonic igneous rocks emplaced only a short time before, document the instability of central Puerto Rico throughout much of its history.

ECONOMIC GEOLOGY

Copper

Chalcopyrite is common as disseminated grains in the diorite and quartz diorite border zone of the Utuado batholith and also occurs in some quartz veins in the border zone and nearby host rocks. In Barrio Zamas, about 1,500 m northwest of Cerro de Punta (134,700 m E.; 38,890 m N.), are four veins 5 to 10 cm wide, trending about N. 55° W., cutting hornfels and chert of the Robles Formation. The vein assemblages include chalcopyrite, cuprite, malachite, azurite, covellite(?), magnetite, quartz, and epidote. Other smaller copper-bearing veins are exposed nearby.

Near kilometer post 6.1 on route 144 at the bridge across Quebrada La Mina (142,280 m E.; 39,840 m N.), numerous veins containing chalcopyrite, pyrite, malachite, and rare disseminated molybdenite occur in grayish-white granodiorite.

Zinc

Two zinc localities were discovered in Jayuya quadrangle. In the Río Inabón about 900 m north of Quebrada Emajagua (137,160 m E.; 34,985 m N.), two 20 by 40 cm pods are alined in a vertical N. 10° W. shear in hornfels, about 100 m south of a granodiorite pluton. Sphalerite, chalcopyrite, zinc carbonate, and pyrite occur in a gangue of coarsely crystalline calcite and talc, and a few grains of native gold were seen in float from the pods.

At about 1,165 m elevation in the east fork of the Río Veguitas, about 120 m north of the crest of the Cordillera Central (136,690 m E.; 37,395 m N.), a 70-cm-wide calcite vein, trending N. 10° E., cuts fine-grained slightly metamorphosed volcanic sedimentary rocks. The vein contains crystal aggregates of chalcopyrite, sphalerite, and galena(?), with some pyrite, talc, and quartz. The trend of the two occurrences is similar, suggesting that they may be exposures of the same zone of mineralization.

Stone and gravel

In 1962 there were no large stone quarries operating in Jayuya quadrangle. Small quarries and borrow pits near highways operate intermittently as sources of road metal, concrete aggregate, and fill, and gravel banks in the Río Grande de Jayuya near Jayuya are also used as a source of aggregate. Lower Tertiary limestone and greenish, bedded fine-grained volcanic rocks similar to those exposed in Jayuya quadrangle have been quarried a few kilometers to the south for use as crushed stone or aggregate, polished stone or marble, dimension stone, and facing stone. Lower Tertiary limestone in localities near the Río Guayo, might be suitable for preparation as agricultural lime.

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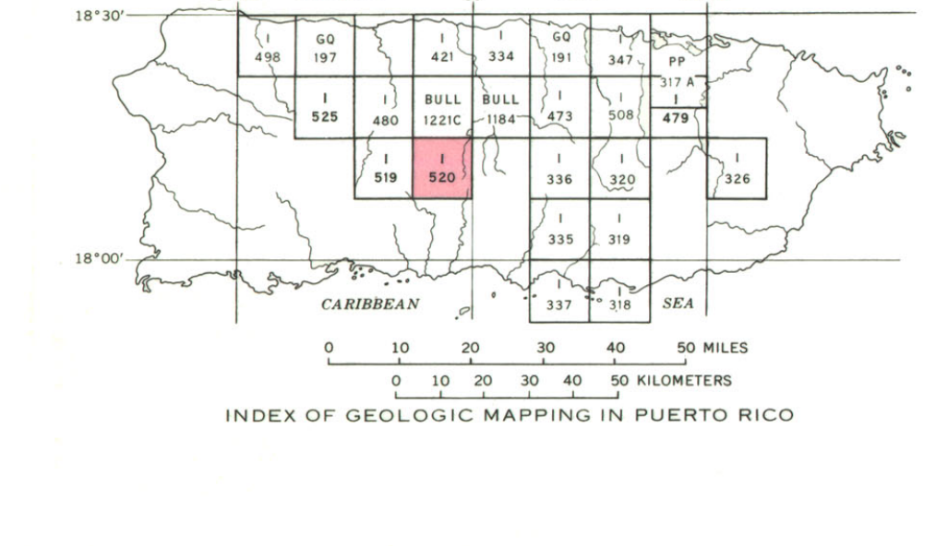

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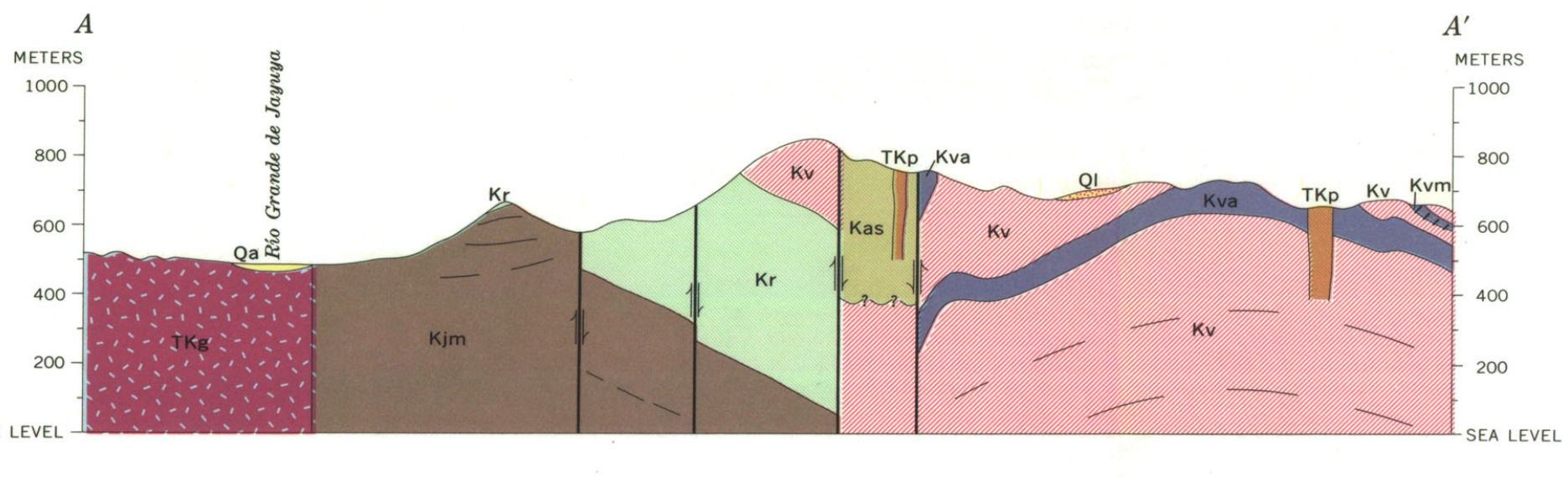

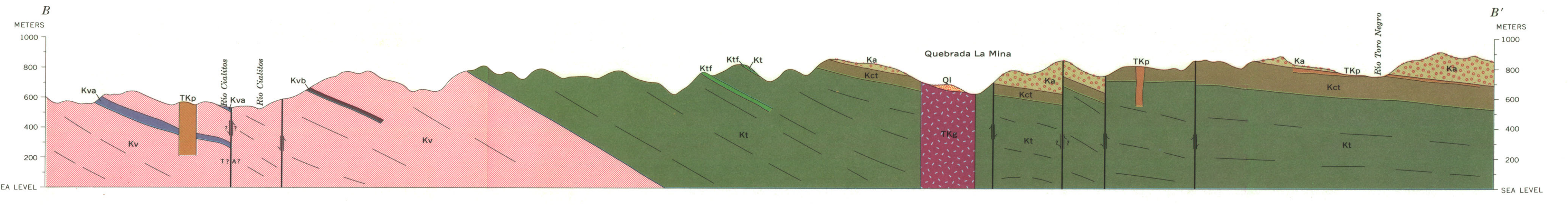

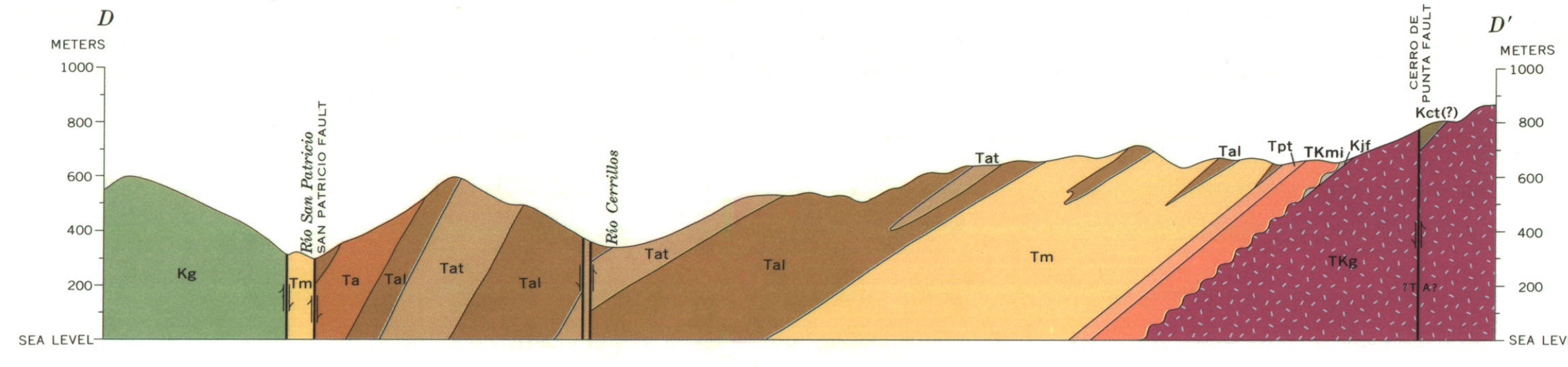

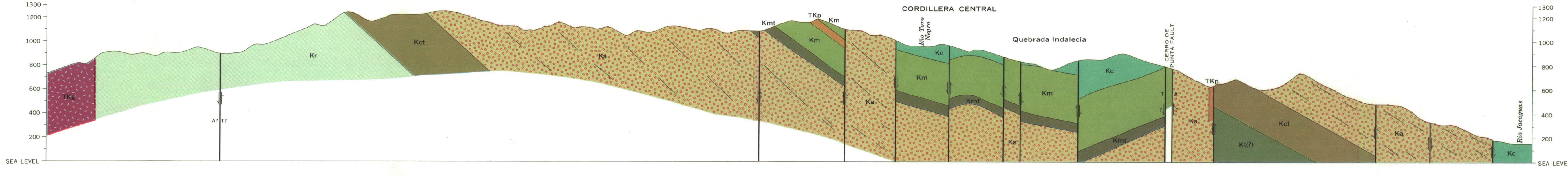

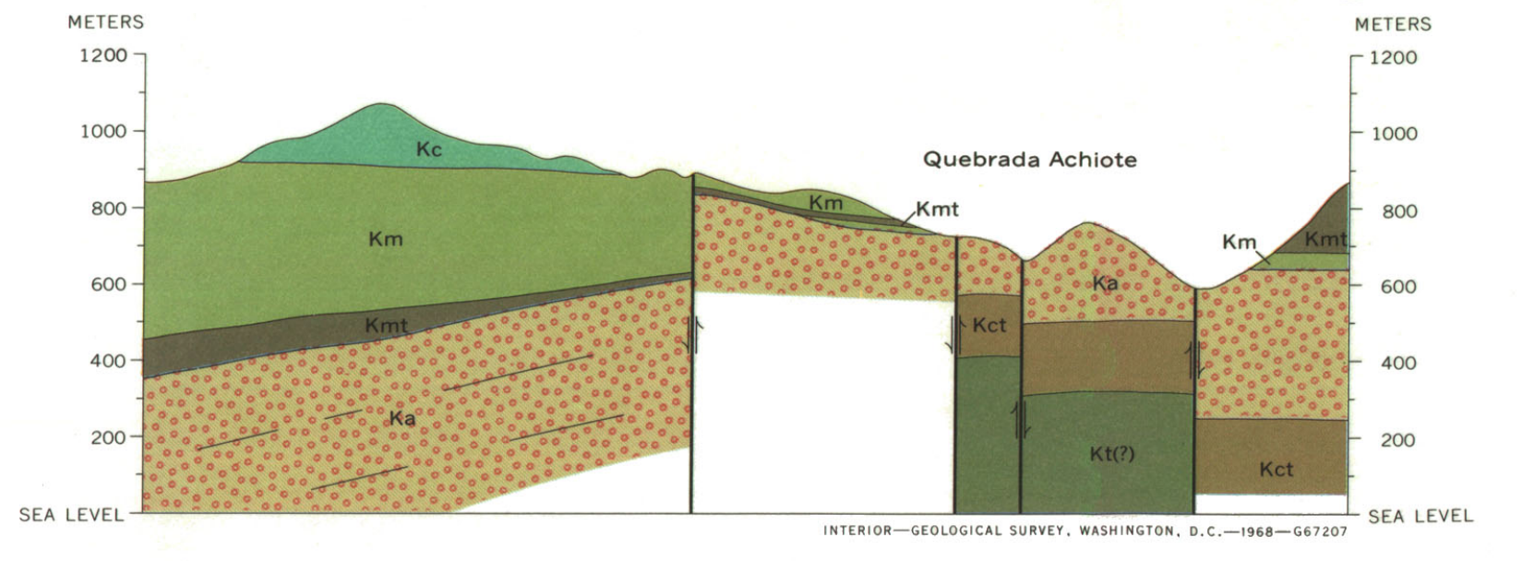

GEOLOGIC MAP OF THE JAYUYA QUADRANGLE, PUERTO RICO

By

Peter H. Mattson

1968